caseous transformation. In the case of some cells, however, the vitality of the cell seems to be unusually great, and thus they go on growing, leading to the formation of a giant cell. A tubercle illustrates very well the fight between cells and bacilli. If the cells are the weaker they quickly die and undergo degeneration, and thus the centre of the tubercle becomes converted into a caseous mass, in which the bacilli may, for a short time, continue to grow. If, however, the cells obtain the victory, the bacilli soon disappear, and a "fibrous tubercle," containing giant cells, is left, in which few or no bacilli can be found. These are the tubercles which, on account of the absence or small number of the bacilli, have led to the formation of various theories as to tubercle being due to a chemical poison, etc. These theories, however, depend, I believe, on misinterpretation of the facts; such tubercles are rather to be regarded as tubercles in which the bacilli have been already destroyed than as growing nodules. Other examples of the formative action of bacteria are seen also in syphilitic affections and in leprosy.

THE SURGERY OF THE PANCREAS, AS BASED UPON EXPERIMENTS AND CLINICAL RESEARCHES.[1]

BY N. SENN, M.D.,

ATTENDING SURGEON TO THE MILWAUKEE HOSPITAL; PROFESSOR OF THE PRINCIPLES AND PRACTICE OF SURGERY AND OF CLINICAL SURGERY IN THE COLLEGE OF PHYSICIANS AND SURGEONS, CHICAGO, ILLINOIS.

(Concluded from page 454, vol. xcii., No. 184.)

CYSTS OF THE PANCREAS.

FOR a general consideration of this part of our subject I refer to my paper on "The Surgical Treatment of Cysts of the Pancreas," in the number of this journal for July, 1885. I allude to this subject again for the purpose of adding new cases and to modify the statement then made concerning the etiology of these cysts. Since then the following additional cases have been reported.

CASE I.—Dixon (*Medical Record*, March 15, 1884) reports an interesting case of cyst of the pancreas, which terminated in death from compression of the bile-duct by the cyst. The patient was a male, forty-two years of age, who during a period of three months had suffered from three attacks of what seemed to be cholelithiasis, before he came under the reporter's care. For the last ten days he became jaundiced. On examination a tumor was found in the region of the gall-bladder, about four inches in diameter, which fluctuated on palpation and ascended and descended synchronously with the respiratory movements, and received the impulse from the underlying aorta. The tumor was punctured and four ounces of a yellowish-red fluid removed which solidified on exposure to the air. Two days after the puncture the tumor was considerably larger than before. The patient's strength gradually failed, until he died, thirty-four days after the puncture. At the necropsy it was ascertained that the tumor was a cyst of the pancreas, with thick walls, and light yellow mucous contents. The cyst occupied the head and part of the body of the pancreas and communicated with the ductus pancreaticus. The tail of the pancreas also contained a small cyst. The large cyst compressed the ductus choledochus in such a manner as to render it entirely impermeable. It is evident that in this case a removal of the pressure by operative treatment might have restored the health of the patient by removing the cause of obstruction to the natural outlet for the bile.

---

[1] Read before the American Surgical Association, Washington, D. C., April 29, 1886.

CASE II.—Reported by Riedel (*Archiv für klinische Chirurgie*, vol. xxxii. p. 994). A woman, forty-five years of age, noticed nine years ago a small tumor in the upper portion of the abdomen, which increased slowly in size until a year and a half before she was examined by Riedel. After this time growth was very rapid, so that a great deal of pain and distress was experienced from the size of the tumor. When she was examined the abdomen was filled completely with a fluctuating tumor, the pelvis and the lateral regions of the abdomen were free. Laparotomy was performed August 27, 1884. The slightly adherent omentum was easily separated, the cyst was tapped, and about ten litres of a brownish fluid escaped. After evacuation of the cyst, the transverse colon could be seen immediately behind the symphysis pubis. The mesocolon had been separated with the omentum. The cyst was separated from the loose attachments with neighboring organs. Troublesome hemorrhage only occurred from the depth of the wound near the vertebral column, where a ligature *en masse* was applied and several vessels tied; the cavity of the wound, the size of two fists, was dusted with iodoform. Death from peritonitis after ninety-six hours. At the necropsy a portion of healthy pancreatic tissue was found ligatured with catgut. The interior surface of the cyst showed, for the most part, a smooth surface without epithelium. At different points it presented prominences which contained glandular tissue.

CASE III.—Reported by Salzer from Billroth's clinic (*Zur Diagnostik der Pancreascyste*, Prag, 1886). Female, thirty-three years of age, not married, was sick with typhus fever when she was eighteen years old. She stated that during her convalescence she noticed a swelling the size of a goose egg in the middle of the abdomen above the umbilicus which disappeared in a few weeks. Four years later the swelling reappeared in the same place, was the size of a fist, but little movable, and rendered the umbilical region prominent. The size of the tumor increased gradually until four years ago it had attained the size of a fœtal head, and had descended below the umbilicus. A sensation of weight in the stomach, vomiting, pain in the abdomen, were the most prominent symptoms during the last fourteen days. Menstruation regular. Before the operation a systematic and careful examination showed no disease in any other organ. Circumference of abdomen below the umbilicus, ninety centimetres. An unusually large vessel was detected in the abdominal walls in the left hypochondrium, which pulsated strongly, and over which, by auscultation, a bruit could be heard. Abdomen prominent, especially in the median line. On palpation the swelling was recognized as a round, smooth, fluctuating tumor, which was in direct contact with the anterior abdominal wall and could be moved slightly from side to side. Percussion dulness over the entire area of the tumor. Both lumbar regions resonant. Spleen and kidney dulness normal. A vaginal and rectal exploration showed that the cervix and uterus were pushed toward the right side, but movable. Behind the uterus a firm tumor could be felt. The diagnosis made at the time was unilocular cyst of the left ovary. Laparotomy was performed June 5, 1885. Median incision exposed the omentum over the cyst, slightly adherent. An opening was made in the omentum, with blunt instruments, through which the cyst wall became visible. The hand introduced through this opening showed the existence of firm adhesions of the cyst wall to neighboring organs. After enlarging the external incision the gastro-colic ligament could be seen stretched over the cyst.

The transverse colon lined the lower border of the cyst, and had descended behind the symphysis pubis. When this portion of the intestine was elevated it was seen that the cyst belonged to the mesocolon. The separation of the cyst presented many difficulties, consequently its size was reduced by tapping, the opening was closed with pressure forceps, and enucleation commenced through a vertical slit in the gastro-colic ligament. Numerous mass ligatures had to be applied to arrest troublesome hemorrhage.

On the left side of the cyst the same enlarged vessel was met with that could be felt externally; it was found so intimately adherent to the cyst wall that it could not be isolated; it was, therefore, ligated double with the accompanying vein, and divided between the ligatures. To facilitate the deep dissection the incision was enlarged upward, and the cyst opened and emptied with the patient lying upon the side. The hand was introduced into the cyst, when it was found that the attached portion extended in an upward direction. The artery previously ligated had to be tied again higher up. In completing the tedious enucleation no pedicle was found.

From the position it could be ascertained that the base of the cyst was in the vicinity of the pancreas.

After careful arrest of hemorrhage at the bottom of the wound, and usual toilette of the peritoneum, the external wound was closed completely, no drainage being used. The patient, who had become considerably collapsed, was rallied by the administration of stimulants. In the evening, temperature was 37.6° C., pulse 72, pain in abdomen, and nausea. Restless during the night. During the next few days pulse became more frequent, jaundice and diarrhœa, great restlessness and collapse, which terminated in death on the sixth day after the operation. At the autopsy extensive purulent peritonitis was found to have been the cause of death. In the transverse mesocolon a hole was found, through which a fist could be passed. Through this opening a cavity, the size of a fist, was entered, the walls of which were infiltrated with blood and pus. In the bottom of this cavity the exposed pancreas was seen, which appeared divided transversely behind the head. Along the margin of the pancreas the splenic artery and vein were found ligated, and a portion of both vessels excised. The middle portion of the pancreas was absent. A portion of the tail of the organ, five centimetres in length, remained. Spleen enlarged to twice its normal size, otherwise normal in structure. Remaining organs healthy. A microscopical examination of the cyst showed that its walls contained pancreatic tissue. Inner surface not lined with epithelial cells.

CASE IV.—Reported by Kramer, operation performed by Hahn (*Centralblatt f. Chirurgie*, No. 2, 1885). Female, sixteen years of age, after an attack of vomiting and pain in the abdomen noticed a gradual distention of the upper portion of the abdominal cavity. The size of the tumor and the area of dulness corresponded to my case. The dulness appeared to be continuous with the hepatic dulness. Echinococcus cyst of the liver was diagnosticated. Laparotomy was performed, and the omentum divided between the stomach and the transverse colon. About two litres of an albuminous fluid were removed by tapping. The cyst was stitched to the margin of the abdominal wound, incised and drained. The patient recovered with an external pancreatic fistula, which continued to secrete pancreatic juice for four months.

REMARKS.—The experiments made for the purpose of ascertaining the effect of complete and permanent obstruction of the pancreatic duct, as detailed in the first part of the paper, have demonstrated conclusively that obstruction is not the only nor the most important element in the causation of a pancreatic cyst. That the ligated portion of the pancreas continued to secrete pancreatic juice was proven by the experiments on external pancreatic fistulæ, and yet, of the many cases of ligation of the pancreas, in not a single instance was a cyst, or even an attempt at the formation of a cyst, observed. The only physical evidence of obstruction was apparent in a moderate and uniform dilatation of the duct behind the ligature. The most important etiological factor in cases of cysts of the pancreas must be sought in an arrest of absorption of the pancreatic juice, due either to a transformation of the pancreatic juice by the admixture of pathological products into a substance which is incapable of being absorbed, or to a loss of function in this direction of the vessels which perform this task.

The obstruction in the pancreatic duct may cause retention and accumulation of pathological products, but can never be the sole cause of retention of pancreatic juice in an otherwise healthy portion of the pancreas. In the cases where normal pancreatic tissue was found in the cyst-walls, it was more than probable that the pathological condition which had caused the obstruction did not effect complete physiological detachment of the peripheral portion of the pancreas; in other words, the obstruction was not complete. In cases where complete physiological detachment has taken place, either by the application of a ligature, or complete obliteration of the duct by pathological conditions, parenchymatous degeneration and atrophy in the detached portion is such a constant result, that the exceptions to this rule must indeed be few, if any. In the diagnosis of pancreatic cysts nothing new has been added. The history of the case, the primary starting-point of the tumor in the epigastric region, its gradual and almost painless growth, are points which should be carefully considered in the differential diagnosis of abdominal cysts. The treatment by extirpation, as only recently practised again by Riedel and Billroth, is not deserving of imitation.

The post-mortem examination in Billroth's case shows only too plainly the difficulties met with in identifying the tissues at such great depth, and of avoiding unnecessary injury to important structures. I wish again to repeat what I had to say on this method of treatment last year. Extirpation of the cyst would guard most effectually against the formation of a permanent pancreatic fistula, but, on account of the deep location of the pancreas, shortness or absence of a pedicle, and the many obstacles thrown in the way of the operator by adjacent organs, the procedure becomes one surrounded by innumerable difficulties and, in the present state of our science, of doubtful propriety. The formation of an external pancreatic fistula in the treatment of cysts of the pancreas has been so uniformly successful that it should be invariably adopted in preference to excision, and the latter operation should only be resorted to in cases where portions of the cyst wall have become the seat of malignant disease, likewise in cases where life is threatened by hemorrhage into a cyst by rupture of vessels lining the interior of the cyst, and which cannot be controlled by simpler and less hazardous measures.

TUMORS OF THE PANCREAS.

Hypertrophy.

Störck (*Annus Medicus*, 1836, Schmidt's *Jahrbücher*, Supplement Band, 1836, p. 161) mentions a case of intestinal obstruction caused by hypertrophy of the pancreas.

CASE I.—A man, forty-eight years of age, previously in good health, had felt a sensation of weight and distress after meals, for more than six months. The flatulency also caused disturbance, and was relieved at times by drinking large quantities of water. Bowels constipated. The symptoms of obstruction developed gradually, but finally became so severe that nothing was retained on the stomach. After obstruction had become complete, the patient became collapsed and died two days later. At the autopsy no signs of inflammation or effusion in the peritoneal cavity could be found. Head of pancreas was found enlarged to the size of an orange, which had so completely compressed the duodenum that its lumen would only permit the passage of a goose quill. Pyloric portion of the stomach enormously dilated, so that this pouch resembled a kind of lesser stomach. The pancreas was softer, more succulent, and fleshier than normal, but not at all indurated.

REMARKS.—As no microscopical examination of the tumor was made, we are unable to classify this case, but considerable doubt must remain whether it was a case of tumor or simple hyperplasia of the gland. The age of the patient and the effect of the tumor upon the duodenum make it quite probable that it was not a case of hypertrophy but carcinoma. The case illustrates the fact that tumors of the pancreas, when they occupy the head of the organ, are liable to produce intestinal obstruction by compression.

Sarcoma.

Of the malignant tumors of the pancreas, carcinoma is of much greater frequency than sarcoma. Only a very few cases of primary sarcoma of the pancreas are on record.

CASE II.—Mayo (*Outlines of Human Pathology*, p. 411) mentions a case of primary sarcoma of the pancreas, with secondary invasion of the stomach, that came under his care. The patient, a man aged thirty-five years, died after an obscure illness which lasted eight months, during which time it was impossible to locate the disease. He dated his illness back to a febrile attack, which left him in a debilitated condition; and from that time he was liable to dyspeptic symptoms, with variable appetite and undefined uneasiness in the epigastric region. A high degree of anæmia was a conspicuous symptom during life. Although the appetite remained good, and digestion did not appear to be very much impaired, emaciation progressed rapidly. On inspection, all the internal parts were found remarkably pale, and void of blood; the heart healthy, but remarkably empty. The pylorus was thickened and firmer than usual, and had contracted adhesions to the pancreas. The pancreas was considerably enlarged and of nearly cartilaginous hardness, except some spots, which were soft, with the appearance of medullary sarcoma. No other disease could be detected in any other part of the body.

CASE III.—Lépine and Cornil ("Contribution à l'anatom. path. du pancréas," *Gaz. Méd. de Paris*, 1874, p. 624) examined the body of a man, sixty-two years of age, who had been sick for eleven months, and had suffered from obstinate vomiting for seven months. The head of the pancreas was found very much enlarged; the remaining portion of it was normal. The small curvature of the stomach was adherent to the tumor, the pyloric orifice thickened and its lumen narrowed. The adhesions involved also the liver, diaphragm, and lower surface of the lung. White metastatic nodules were found in both kidneys. Under the microscope, section of the tumor revealed a sarcomatous structure.

REMARKS.—In the two cases related here we have the principal types of clinical behavior of sarcomatous tumors. In the first case the disease involved almost the entire organ, having given rise to extensive local destruction without metastasis; in the second case the disease was limited locally to the head of the pancreas, while it had extended early by contiguity to adjacent organs and by metastasis to distant organs.

Friedreich (Ziemssen's *Cyclopædia*, vol. viii. p. 614) claims that at present we are acquainted with only one reliable case of primary sarcoma of the pancreas. It is described by Paulicki, and was found to be of the small-celled variety; it was taken from the body of a young man who had died of pulmonary and intestinal phthisis. It had not given rise to any noticeable symptoms during life.

Carcinoma.

It is claimed by some pathologists that primary cancer of the pancreas is an exceedingly rare affection, and that in the majority of cases in which this organ is the seat of the lesion, it occurs as a secondary affection, having reached it by extension from an adjacent organ, especially from the pyloric extremity of the stomach. While this may be true in many cases, quite a number of specimens have been examined in which the disease occurred here as a primary affection. Suche ("De Scirrho pancreat. nonnula," Dissert. Berol., 1834) appears to have examined a specimen which affords a good illustration of primary cancer of the body of the pancreas. The middle of the gland was converted into a hard, irregular, nodulated mass, of the size of a fist, which rested directly upon the aorta, which imparted to it pulsation during life. When cut into, the tumor grated under the knife, and the cut surfaces presented a laminated appearance. The substance of the tumor was traversed by numerous large veins; both extremities of the pancreas were healthy, and no secondary nodules could be found in any portion of the body. A primary cancer of the pancreas is also described by Schupman (*Hufeland's Journal*, 1841), where the tumor had formed adhesions with the spleen, while the liver contained a number of metastatic deposits. The terminal extremity of the pancreatic duct contained a cylindrical calculus with a number of arborescent projections, which corresponded to the contributory ducts. In another case, reported by Récamier (*Rev. Méd.*, 1830), the cancerous tumor, which involved the tail of the pancreas, was connected with the left kidney and compressed the ureter. The right half of the pancreas was healthy, the diseased portion gray, hard, and lardaceous. The pelvis of the left kidney, in consequence of the compression of the ureter, was hydronephrotic. The remaining organs were healthy.

Bright, in 1832, reported a number of cases of primary carcinoma of the pancreas, with a special view of illustrating the effect which disease of this organ would have upon the digestion of fat. In three out of eight cases he noticed fatty diarrhœa, and he was inclined to the belief that this symptom, when present, was almost pathognomonic of the existence of disease of the pancreas ("Cases and Observations Connected with Disease of the Pancreas," *Medico-Chirurgical Transactions*, vol. xviii. p. 1).

In all cases the fatty diarrhœa was associated with jaundice. The following post-mortem account (p. 17) leaves no doubt that the disease was primarily limited to the pancreas:

> "The cause of the pressure on the bile-ducts was immediately obvious; for, on placing the hand near the pylorus, a hard lump, of the size of a common egg, was easily felt, and was soon discovered to be the head of the pancreas itself, and not the glands surrounding that part, forming a yellow mass like the boiled udder of a cow, almost cartilaginous in hardness. Its texture was uniformly hard and unyielding, and the whole pancreas partook of the same, but in a less degree. The head of the pancreas was firmly and inseparably glued to the duodenum, and the hardness very nearly surrounded the viscus."

As undoubted instances of primary cancer of the pancreas, we must mention the published cases of Muehry (*Casper's Wochenschr.*, No. 10, 1835), Albers (*Med. Corrspbl. rhein. u. westf. Aerzte*, No. 8, 1843), Haldaure (*Assoc. Med. Journ.*, May, 1854), Webb (*Phila. Med. Times*, vol. ii., December, 1871), Gross (*Ibid.*, vol. ii., June, 1872), Luithlen (*Mem. a. d. aerztl. Praxis*, 1872, vol. xvii. p. 309), Roberts (*British Med. Journ.*, Sept. 1865), Wagner (*Archiv d. Heilk.*, vol. ii. p. 285), Bowditch (*Boston Med. and Surg. Journ.*, July, 1872), Davidsohn (*Ueber Krebs der Bauchspeicheldrüse*, Dissert. Berlin, 1872), Williams (*Med. Times and Gaz.*, August, 1852), and Frerichs (*Klin. d. Leberkrankheiten*, vol. i. pp. 146 and 153), as referred to by Friedreich ("Diseases of the Pancreas," *Ziemssen's Cyclopædia*, vol. viii. p. 608).

According to Da Costa (*North Am. Med. Chir. Review*, September, 1858), cancer of the pancreas is more frequent in the male than in the female, and in preference attacks people more than forty years of age. It usually appears as a firm tumor or scirrhus, with a well-developed connective tissue reticulum. Other varieties of carcinoma have been described. Thus, Wagner observed a cylindroma, and Lücke and Klebs have each met with the colloid variety. The primary starting-point is usually in the head of the organ, whence it extends in all directions. By extension within, it successively invades the body and tail of the organ, until the whole gland is involved, when it forms a nodulated spherical tumor. The extension of the growth in an opposite direction soon reaches the duodenum, where it produces a narrowing or complete stenosis of that portion of the intestinal canal. A case of this kind is related by Hœlscher, in which the duodenum was constricted to such an extent that it was entirely impermeable, and the patient suffered for several days from symptoms of intestinal obstruction. While cancer of the stomach is liable to extend to the pancreas, the reverse is not frequently observed. When the carcinoma develops primarily in the pancreatic ducts, it belongs to the variety called cylindroma. The lymphatic glands in the vicinity of the pancreas are invariably affected during the later stages of the disease.

Stearrhœa is an important but not infallible symptom of cancer of the pancreas. It is attributed to an absence of the pancreatic juice from the intestinal canal, caused either by obstruction in the duct or suspension of the physiological function of the organ by the neoplastic infiltration. Epigastric pain is an early and important symptom, and is the result of compression of the cœliac plexus by the tumor. The pain often assumes a neuralgic character, and is usually not aggravated after taking food. Vomiting is a frequent symptom, and the matter ejected is generally a watery fluid, sometimes stained with bile. Constipation is an almost constant symptom. Progressive emaciation and anæmia attend malignant disease in any locality, but are unusually well marked in cancer of the pancreas. When the disease extends toward the duodenum, jaundice occurs from stenosis of the bile-ducts by compression or direct invasion by the neoplasm. Bruen has called attention to some forty cases of jaundice due to primary carcinoma of the head of the pancreas, lately reported by another observer, from which it is demonstrated that jaundice is an invariable symptom of primary scirrhus of the head of the pancreas, while it is uncommon when the disease is secondary, or affects the body or tail of the organ.

The most reliable evidence is the appearance of a tumor in the epigastrium behind the stomach. The difficulty of examining the pancreas during health by palpation is appreciated when a physical examination is to be relied upon in locating tumors in this locality. The normal pancreas can be felt only under the most favorable conditions through a thin and relaxed abdominal wall, but in determining its relative size this method of examination affords but little reliable information. A cancer of the pancreas, when it can be felt by palpation, appears in the epigastrium as a hard, immovable, or only slightly movable tumor, which is evidently deeply seated in the abdominal cavity. Under favorable conditions the connections of such a tumor with the pancreas can sometimes be demonstrated during life, but a positive diagnosis becomes impossible when, as in most of the cases hitherto recorded, it constitutes merely a part of a general tumefaction of the abdomen. As the tumor is in such close proximity to the abdominal aorta the pulsations of this vessel are imparted to the tumor, and a bruit may even be heard over the compressed vessel; but, in contradistinction to aneurism, the pulsation is felt in only one direction, and the bruit disappears when the patient is placed in the knee-elbow position, as the tumor is lifted from the vessel by the force of gravitation.

That the tumor cannot be always felt is evident from the statement made by Da Costa that he recognized it in only 13 out of the 137 cases he reported; and Bigsby, in an analysis of 15 cases, alludes to its being recognized in only 4.

From what has been said, it will be seen how uncertain the symptoms are in the diagnosis of cancer of the pancreas. A satisfactory conclusion can be reached only after a careful consideration of the history of the case combined with a systematic elucidation of all the symptoms presented, and more particularly by resorting to the advantages to be derived from a systematic and careful study by exclusion.

A positive diagnosis of malignant disease of the pancreas is only possible after the tumor has attained sufficient size to be recognizable by palpation, consequently too late for a radical extirpation. When the disease has advanced to this stage it has already involved the greater portion of the gland and, as a rule, has invaded important adjacent organs. Another important element in the surgical treatment of cancer of the pancreas consists in the fact that the disease, as a rule, develops primarily in the head of the organ, a location which, in itself, precludes the propriety of an operation. The most favorable conditions for extirpation are presented if the disease is primarily located in the tail of the pancreas, and has not passed beyond the limits of the capsule of the gland. In such a case, excision of the splenic extremity of the pancreas would offer a fair prospect for a permanent result without endangering, as a remote consequence, the process of digestion, as a sufficient amount of secreting structure would remain in connection with the intestine to maintain pancreatic digestion.

Billroth, in two instances, made a partial resection of the pancreas in removing carcinomatous tumors of adjacent organs. In one case he removed a portion of the head of the pancreas with a cancer of the pylorus, and in another case he removed the tail of the pancreas with a sarcomatous spleen. Both patients recovered from the immediate effects of the operation. In the case of partial excision of the head of the pancreas it is to be assumed that the duct was not injured, that the organ continued to secrete, and the pancreatic juice was discharged into the duodenum through the uninjured duct. In operating upon the head of the pancreas for malignant disease which has extended to it from an adjacent organ, it is essential to preserve the continuity of the duct, so as to prevent physiological detachment of the remaining portion of the gland, an accident which would be followed by degeneration and complete atrophy, consequently suspension of pancreatic digestion. If an operation is performed for cancer of an adjacent organ, and the disease has extended to the splenic extremity of the gland, the operation should not be completed without removing a sufficient portion of the pancreas to guard against a local recurrence of the disease in this organ. As in cases of partial excision of the pancreas for other lesions, the pancreas should be ligated before it is divided, so as to prevent troublesome hemorrhage, and at the same time guard against extravasation of pancreatic juice into the peritoneal cavity.

Tuberculosis of the Pancreas.

Primary tuberculosis of the pancreas is an exceedingly rare affection; indeed, some pathologists, among them Louis and Lebert, doubt its primary origin in this organ. Cruveilhier only mentions tubercular degeneration of the lymphatic glands upon the surface of the pancreas. In diffuse miliary tuberculosis of the abdominal organs Klebs could find no nodules in the substance of the pancreas on microscopical examination. But in such a condition the gland is often found in a state of parenchymatous degeneration which has been incorrectly interpreted as the first stage of tuberculosis by Ancelet.

When the lymphatic glands around the pancreas have undergone cheesy degeneration we sometimes find similar deposits in the pancreas, which, however, may be cheesy lymphatic glands in the substance of the pancreas itself. Hartmann mentions a case where the pancreas had disappeared completely and its place was occupied by a cheesy mass. Although the pancreas is not disposed to tuberculosis, we have reliable information that in a number of cases this gland was the primary seat of the process.

Case I.—Reported by Aran (*Archiv gén. de Méd.*, 1846). The patient was a woman, twenty-five years of age, who died of a lingering disease. She had been sick for a year, during which time she felt exceedingly weak, had frequent attacks of vomiting, and the skin became deeply bronzed, in some places almost black. The pain, which was severe at times, was referred to the epigastrium. The necropsy showed a tubercular deposit in the tail of the pancreas the size of a hen's egg, surrounded by a zone of miliary deposits in the substance of the gland. Miliary tubercles were also found in the spleen.

Case II.—Mayo (*Outlines of Human Pathology*, p. 410) describes a case where we have reason to believe that the process commenced primarily in the pancreas. The patient was an inmate of Middlesex Hospital, and was under the care of Dr. Wilson. He was thirty-eight years of age and had been ill for sixteen weeks; during the last seven weeks he was confined to his bed. The first symptoms were pain in the abdomen extending along the right hypochondrium to the spine. Twenty-eight days before death he became jaundiced, stools white, urine high colored; for some time he could lie on the right side only, and was often obliged to sit upright to draw breath. A large abdominal tumor had been felt immediately above the umbilicus some time before death, and the right arm and side of the neck had become œdematous.

Autopsy: serous effusion into the right pleural cavity. The gall-bladder was distended to a great size so as to contain eight ounces of fluid. The distention arose from an enlargement of the pancreas, the head of which formed an irregular sphere four inches in diameter, which had compressed the gall-duct; the rest of the gland was likewise enlarged. In parts it presented its natural texture and color, at other parts it was infiltrated with tubercular matter, which at two or three points had softened and formed thick pus. A few lymphatic glands, the thymus gland, and kidneys, appeared to be secondarily involved.

REMARKS.—Although in both of these cases the symptoms during life pointed to disease of the pancreas a sufficiently positive diagnosis to warrant a laparotomy could only have been made after a palpable tumor appeared, and after this time the disease had already passed beyond reach by the appearance of miliary deposits in other organs, an occurrence which would preclude the justifiability of any operative interference. Should abdominal section be performed in a case of tubercular peritonitis, and should such a condition in the pancreas be found as in Aran's case, it would be proper to extirpate the terminal end of the pancreas inclusive of the tubercular abscess.

In Wilson's case the tubercular deposit in the pancreas gave rise to a large abdominal tumor due partly to the distended gall-bladder, and as such a condition might present itself to the surgeon, in these days of diagnostitial laparotomy, it might be advisable, and to the advantage of the patient to establish an external pancreatic fistula instead of closing the wound. Such a course would enable the surgeon to remove the cheesy material, disinfect the abscess cavity, and to treat its interior with iodoform, all of which, done under antiseptic precautions, would tend to modify favorably the local process.

The removal of compression of the bile-duct by the same procedure would also tend to reëstablish the interrupted communication between the bile-ducts and the duodenum by removing the cause of the stenosis.

LIPOMATOSIS OF THE PANCREAS.

Lipomatosis, or fatty infiltration of the pancreas, is a pathological condition of this organ which is characterized by a transformation of the interacinous connective tissue into fat in contradistinction to fatty degeneration of the parenchyma cells, which sometimes occurs as an independent affection. In cases of fatty infiltration the shape and size of the pancreas may remain normal, but the secreting structures themselves may have completely disappeared by pressure atrophy. This disease is of little interest to the surgeon, except that it may serve as a predisposing cause of interstitial hemorrhage, in which connection it has already received mention; it is here again alluded to as a separate affection to demonstrate that gradual atrophy of the pancreas, even to the extent of complete disappearance of the glandular structures may occur without causing serious impairment of the digestion. Rokitansky (*Lehrbuch der path. Anat.*, vol. iii. pp. 313 and 369) has found this condition of the pancreas generally as a part and parcel of a general obesity, especially in intemperate persons, together with fatty liver, heart, and omentum. In the three cases of pancreatic apoplexy described by Zenker, the fatty infiltration of the pancreas was only one of the many evidences of a diffuse malnutrition of the tissues. In some of these cases the patients exhibited no symptoms during life indicating the absence of the pancreatic secretions, and yet, on making the post-mortem examinations, complete destruction of the glandular structure was found.

Litten has reported three cases of complete atrophy of the pancreas, in which, during life, no symptom of pancreatic disease was observed, such as fatty stools, salivation, lipuria, bronzed skin, cœliac neuralgia, etc. (*Charité Annalen*, 1881). In two cases the atrophy was due to pressure, and in one instance it was caused by primary cancer of the pancreas.

In other cases the suspension of the pancreatic function by fatty degeneration of the organ produces well-marked symptoms during life, and may even result in death. Such a case is reported by Lépine and Cornil (*Gaz. Méd. de Paris*, p. 624). The patient was a drunkard, fifty-seven years of age. For six months he had been ailing with indigestion, marked loss of weight, diarrhœa alternating with constipation, no fever, no vomiting. For two months his body was covered with an eruption, and his feet became œdematous. At the autopsy the pancreas was found normal in size and shape, but the parenchyma of the gland had entirely disappeared, and its place was occupied by adipose tissue. The pancreatic ducts were filled with a viscid whitish fluid and small concretions. No other cause of death could be found in any of the remaining organs. Clinical observation appears to confirm the results obtained by experiments on animals, that in some instances complete gradual atrophy of the pancreas is compatible with normal digestion, while, in other cases, the suspension of the pancreatic secretion is followed by serious disturbance of digestion, marasmus, and death from inanition.

The only plausible explanation of the different effects of the same cause can be found in the supposition that in some individuals the compensating function of vicarious organs maintains normal digestion, while in others no such compensating action is established.

LITHIASIS OF PANCREATIC DUCTS.

Concretions of carbonate and phosphate of lime are frequently found in the pancreatic ducts. They are usually multiple, small, whitish, smooth, or of rough and irregular shape. Calculi in this locality have been found which measure more than an inch in diameter. In Shupmann's case, the calculus weighed 200 grains and measured one and a half Paris inches in length, and from five to six Paris lines in diameter; having a crystalline surface, with processes running into smaller ducts. It was found in the left extremity of Wirsung's duct.

Sometimes the concretions of calcium phosphate and carbonate exist in incrustation of the mucous lining of the ducts. According to Collard de Martigny, the calculous concretion is sometimes composed of phosphate of lime alone. The calculi in this locality are usually solid formations, of fine granular structure with somewhat rough surfaces and very often covered with sharp points of projection. In some specimens the stone presents numerous branches which correspond to smaller pancreatic ducts. The irritation incident to the presence of a calculus in the pancreatic duct is followed by consecutive pathological changes in the duct and glandular tissue of the organ itself. The substance of the organ in the immediate vicinity of the stone becomes the seat of interstitial inflammation, followed by atrophy and sclerosis; the cicatricial tissue produced by this change causes contraction, an occurrence which may still further aggravate the obstruction. In most instances this inflammatory process does not remain localized but extends over the entire gland, as in the cases observed by Engel, Elliotson, and Curnow. In some cases the concretion gives rise to suppuration, as in Portal's case. His patient had died suddenly with symptoms of aneurism of the aorta, and at the autopsy an abscess was found in the head of the pancreas which contained a number of biliary and pancreatic calculi. In Fauconneau-Dufresné's case, as quoted by Ancelet, the left half of the pancreas contained a number of abscesses, one of which had perforated into the stomach. The pus contained numerous concretions from the size of a pin's head to that of a bean. Salmade observed a case of lithiasis complicated with abscess of the pancreas, where the swelling compressed the underlying aorta to such an extent, that death was produced by the rupturing of a vessel from overdistention on the proximal side of the obstruction.

Mr. Moore (*Lancet*, Jan. 12, 1884) presented to the Pathological Society of London, the pancreas of a man, aged forty-three years, who died in St. Bartholomew's Hospital of an attack of pleurisy following gouty symptoms. The main duct of the organ was slightly dilated and contained a calculus of irregular shape, around which was a large abscess in the head of the organ. This abscess pressed upon the orifice of the bile-duct sufficiently to produce great distention of the gall-bladder. A number of cases of cysts of the pancreas have been reported in connection with a calculus in the duct on the proximal side of the cyst, and in which the dilatation of the duct was attributed to obstruction, due to the presence of the foreign body in the duct. Complete stenosis of the pancreatic duct, due to intrinsic or extrinsic causes, is always followed by parenchymatous degeneration of the glandular tissue on the peripheral side of the seat of obstruction, which necessarily arrests the physiological function in that portion of the organ, hence we are unable to explain the retention of the secretion from this cause unless impaction of the calculus takes place suddenly. Again, assuming this to be the case, we know that healthy pancreatic tissue will remove its own secretion by absorption in case of sudden stenosis or obstruction of the duct. We are therefore forced to explain the occurrence of a pancreatic cyst in the course of gradual or sudden obstruction of the ducts by a calculus, cicatricial or malignant stenosis, to parenchymatous changes in the peripheral portion of the gland rather than to the obstruction. This argument, of course, applies only to the so-called retention cyst. Simple, uncomplicated obstruction of the duct may give rise to accumulation of pathological products which under no circumstances are amenable to removal by absorption. The former assertion is well illustrated by the specimen which Norman Moore (*Lancet*, Jan. 12, 1884) exhibited before the Pathological Society of London, which showed great dilatation of the common pancreatic duct throughout its entire length. Near the orifice the duct was obstructed by a small calculus of irregular shape. The whole gland was hard, and to the naked eye showed great connective tissue hyperplasia. The papilla in the duodenum was enlarged and the hardened tissue of the pancreas constricted the bile-duct so as to cause complete obstruction. The liver showed secondary changes due to the stasis of bile. A microscopical examination of the specimen showed it to be a case of genuine cirrhosis of the pancreas, only a small number of acini remaining in healthy condition. In this case the cirrhotic change in the organ was undoubtedly produced in the same manner as by constriction of the duct as practised in the experiments on animals, the first link in the chain of pathological changes being the mechanical obstruction of the duct by the calculus.

Positive diagnosis of pancreatic lithiasis during life is impossible. Calculi and concretions have been found at post-mortem examinations of persons who, during life, did not suffer from any symptoms indicating such conditions. Pain, fatty stools, hæmatemesis, diabetes, are symptoms sometimes associated with this lesion of the pancreas, but when present they point rather to the existence of a consecutive lesion of the substance of the gland produced by the calculus than to the presence of the calculus itself. If the calculus be arrested at the outlet of Wirsung's duct it may, at the same time, obstruct the outlet of the bile by compressing the ductus choledochus and so cause jaundice. But the same effect can also be produced by cirrhosis of the head of the pancreas, with or without the presence of a calculus in the pancreatic duct. Mr. Morris claims that he has seen cases of pancreatic stone colic, but in such cases it would be impossible to differentiate between the passage of a biliary and a pancreatic calculus along their respective ducts, as a biliary calculus may obstruct the common pancreatic duct and *vice versâ*.

As the diagnosis of a calculus of the pancreas, *intra vitam*, is impossible, the surgical treatment must be limited to the management of some of its consecutive lesions—cysts, abscess, and retention of bile.

The treatment of cystic disease and abscess of the pancreas has been considered under their respective headings, and I will only add that when these conditions have been caused by an impacted calculus, an effort should be made to recognize the primary cause and, if possible, to remove it. As the surgical treatment of retention of bile due to the mechanical obstruction of the biliary passages is now receiving much attention, it is well, in this connection, to call the attention of surgeons to impaction of a pancreatic calculus in the duodenal portion of the pancreatic duct as an occasional cause of obstinate jaundice. If, in a case of this kind, abdominal section should reveal the true nature of the obstruction, an effort should be made at the time to force the calculus into the duodenum by taxis, and if this cannot be accomplished, the propriety of cutting for the stone should be carefully considered. As an impacted calculus in this locality not only endangers the life of the patient by cholæmia, but may also destroy life suddenly by perforation into the abdominal cavity, it would be not only justifiable but good treatment to remove it after a positive diagnosis has been made by means of diagnostitial laparotomy. The greatest danger attending such a procedure would be extravasation of bile into the peritoneal cavity. This accident should be guarded against by removing the retained bile by aspirating the dilated bile-ducts as a preliminary measure. After extraction of the stone the incision in the duct should be accurately closed with fine silk sutures. The secretion of bile and pancreatic juice should be reduced to a minimum after the operation by keeping the digestive organs in a condition of absolute physiological rest during the time required for the healing of the visceral wound.

In conclusion I submit the following propositions:

1. Restoration of the continuity of the pancreatic duct does not take place after complete section of the pancreas.

2. Complete extirpation of the pancreas is invariably followed by death, produced either by the traumatism or gangrene of the duodenum.

3. Partial excision of the pancreas for injury or disease is a feasible and justifiable surgical procedure.

4. Complete obstruction of the pancreatic duct, uncomplicated by pathological conditions of the parenchyma of the organ, never results in the formation of a cyst.

5. In simple obstruction of the pancreatic duct, the pancreatic juice is removed by absorption.

6. Gradual atrophy of the pancreas from nutritive or degenerative changes of the secreting structure is not incompatible with health.

7. Physiological detachment of any portion of the pancreas is invariably followed by progressive degeneration and atrophy of the glandular tissue.

8. Extravasation of fresh normal pancreatic juice into the peritoneal cavity does not produce peritonitis, but is promptly removed by absorption.

9. Crushed or lacerated pancreatic tissue is removed by absorption, provided the site of operation remains aseptic.

10. Complete division of the pancreas by elastic constriction is never followed by restoration of interrupted anatomical continuities.

11. Limited detachment of the mesentery from the duodenum, as required in operations upon the pancreas, is not followed by gangrene of the bowel.

12. In all operations upon the head of the pancreas, the physiological connection of the peripheral portion of the gland should be maintained by preserving the integrity of the main pancreatic duct.

13. Partial excision of the splenic portion of the pancreas is indicated in cases of circumscribed abscess and malignant tumors, in all cases where the pathological product can be removed completely without danger of compromising pancreatic digestion or inflicting additional injury upon important adjacent organs.

14. Ligation of the pancreas at the point or points of section should precede extirpation as a prophylactic measure against troublesome hemorrhage and extravasation of pancreatic juice into the peritoneal cavity.

15. The formation of an external pancreatic fistula by abdominal section is indicated in the treatment of cysts, abscesses, gangrene, and hemorrhage of the pancreas due to local causes.

16. Abdominal section and lumbar drainage are indicated in cases of abscess or gangrene of the pancreas where it is found impossible to establish an anterior abdominal fistula.

17. Thorough drainage is indicated in cases of abscess and gangrene of the pancreas, with diffuse burrowing of pus in the retroperitoneal space.

18. Removal of an impacted pancreatic calculus in the duodenal extremity of the duct of Wirsung, by taxis or incision and extraction, should be practised in all cases where the common bile-duct is compressed or obstructed by the calculus and death is threatened by cholæmia.

19. In such cases the principal source of danger, extravasation of bile into the peritoneal cavity, should be avoided by preliminary aspiration of the dilated bile-ducts, accurate closure of the visceral wound with fine silk sutures, and absolute physiological rest of the organs of digestion during the time required in the healing of the visceral wound.